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(54) Abstract Title
Treatment of chocolate

(57) A method for modifying the flow pattern of a stream of chocolate to assist in the coating, covering or enrobing of food items, comprises an atomisation nozzle in which a liquid stream of chocolate is supplied via the pipe 10 and is discharged through the orifice 12 to flow towards a curved surface 16a.

A control fluid which is normally air is supplied through a plurality of nozzles 22 and exits from each of the individual nozzle orifices 24.

The control fluid both impinges upon the liquid stream as it passes along the axis A and attaches to the Coanda surface 16a in order to produce the right combination of impingement and shear flow atomisation.

Pressurisation of the liquid stream internally aids further with the atomisation, this being achieved by supplying a gas flow through the pipe 18, this gas flow discharging co-axially with the liquid stream at the exit 18a.

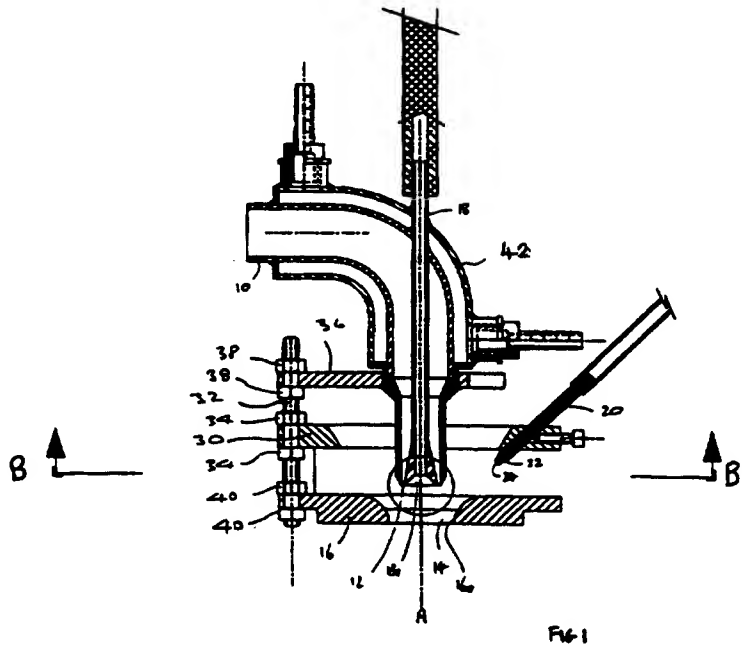

Fig 1

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The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1995

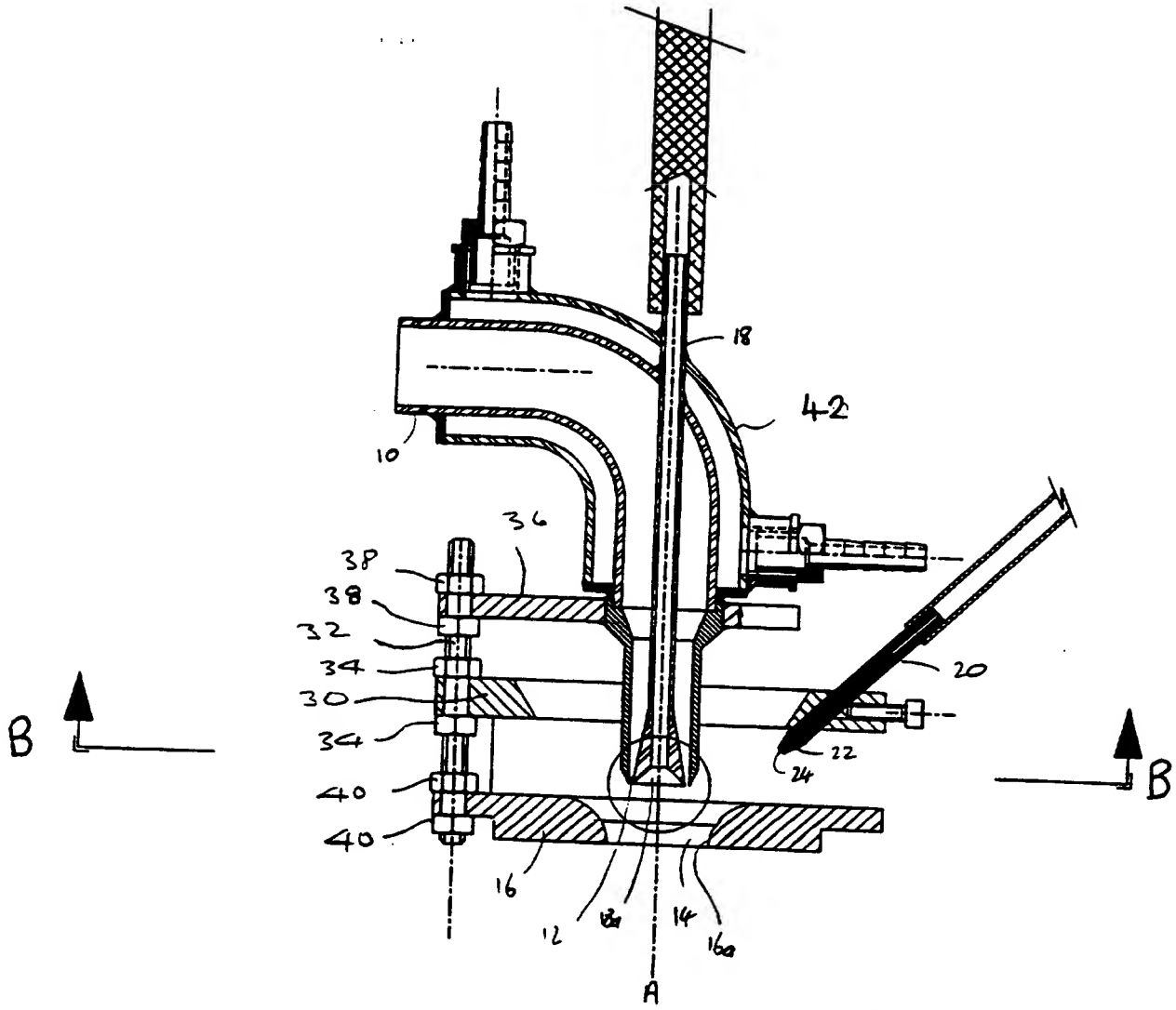

FIG 1

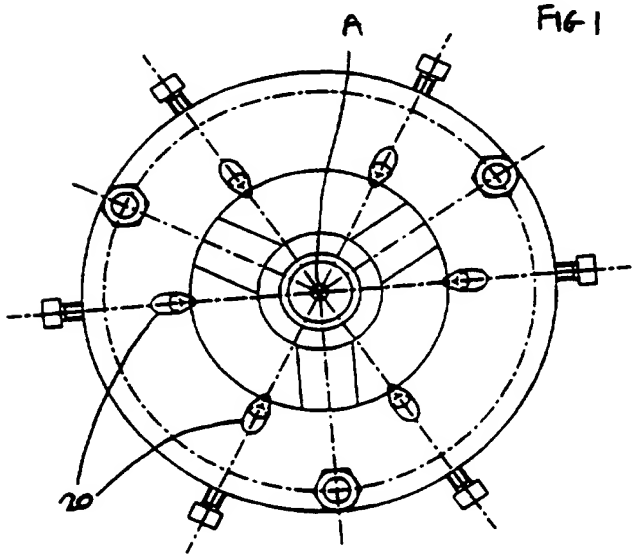

FIG 2

TREATMENT OF CHOCOLATE

This invention relates, in at least one of its aspects, to the treatment of chocolate and is more particularly, but not exclusively, concerned with modifying the flow pattern of a stream of fluid chocolate composition to assist in the coating, covering or enrobing of food items such as peanuts, raisins, caramels and other self-supporting confectionery centres etc, with chocolate.

Discrete food items such as peanuts and raisins are commonly covered in chocolate by a process known as "panning". One technique involves spraying liquid chocolate from spray guns into a rotating pan containing such food items so as to build up an even deposit of chocolate thereon.

In view of its viscosity, it is difficult, using spray guns, to supply liquid chocolate having the usual fat content of about 29 - 30 wt%. Thus, it is common practice to reduce the viscosity by inclusion of about 3 to 4 wt% of extra fat, which is generally considered to be undesirable from the health viewpoint. Additionally, it has been found that the use of spray guns can have an adverse effect on the quality of the resultant chocolate coating, notably the texture or mouthfeel of the chocolate coating.

It is an object of a first aspect of the present invention to provide a process for modifying the flow pattern of a stream of fluid chocolate composition which can enable the above disadvantages of spray guns to be obviated or mitigated.

According to said first aspect of the present invention, there is provided a method of modifying the flow pattern of a stream of chocolate, comprising the steps of causing the chocolate stream to flow in a predetermined flow path adjacent to and past at least one curved surface which is curved in the direction of flow of the stream; and supplying a control fluid to said at least one curved surface between the surface and the chocolate stream so as to cause the control fluid to follow said at least one curved surface by virtue of the Coanda effect whereby to modify the flow pattern of the chocolate stream.

The use of the Coanda effect permits the flow pattern of the chocolate stream to be changed by a technique which can enable the temperature of the chocolate to be accurately controlled. This technique can also permit higher viscosity chocolate (e.g. chocolate having a relatively low fat content) to be successfully atomised than has heretofore been possible by forcing the chocolate through spray guns.

The control fluid, which will usually be a gas such as air, nitrogen or carbon dioxide, may be supplied at a temperature and velocity such as to provide flow pattern modification by a mechanism which does not necessarily involve raising the temperature of the stream. It will be understood, in this regard, that forcing chocolate through spray guns can cause heating of the chocolate by virtue of the frictional forces developed within the spray guns. Thus, the method of the present invention can be used to atomise a stream of tempered chocolate with a reduced risk of the chocolate becoming detempered as compared with the use of conventional spray guns. If desired, the supply for the chocolate stream may be heated or jacketed to maintain it at the desired

temperature. The temperature of the control fluid may also be varied so as to achieve the required temperature of the stream.

The velocity of the control fluid, when passing in co-current fashion with the stream of chocolate, most preferably exceeds that of the stream of chocolate so that, as the control fluid passes over the curved surface, it exerts a shear force on the chocolate stream which causes the aforesaid flow pattern modification. It is thus possible to induce at least a degree of atomisation of the stream solely as a result of this shear force due to the control fluid following the curved surface by virtue of the Coanda effect. However, it is also within the scope of this aspect of the present invention to arrange for one or more portions of the control fluid to impinge directly against the chocolate stream to effect additional flow pattern modification. This enables a particularly close control over the degree of flow pattern modification to be effected.

It is an object of second and third aspects of the present invention to provide an improved method and apparatus for modifying the flow pattern of a liquid stream which may be of any type, for example chocolate, spray-release agent, sugar syrup etc, such as to permit a close control over atomisation or other modification of the flow pattern of the liquid stream.

According to said second aspect of the present invention, there is provided apparatus for modifying the flow pattern of a liquid stream, comprising a discharge outlet; means for supplying a liquid to said discharge outlet so as to cause a stream of liquid to be discharged along a predetermined flow path from the discharge outlet in use; at least one curved surface which is spaced downstream of said discharge outlet and

which is curved longitudinally of said flow path; and a control fluid supply means disposed relative to said at least one curved surface so as to cause a control fluid to be introduced between said flow path and said at least one curved surface and so as to follow said at least one curved surface by virtue of the Coanda effect whereby said control fluid interacts with and modifies the flow pattern of the liquid stream in use; wherein said control fluid supply means includes a plurality of discrete orifices which are mutually spaced apart transversely of the predetermined flow path and which are directed towards said flow path so that, in use, discrete portions of the control fluid impinge directly against the liquid stream whilst other portions of the control fluid follow said at least one curved surface by virtue of the Coanda effect.

By the provision of discrete orifices used to supply the control fluid, a close control over the flow modification pattern can be achieved compared with the types of apparatus described, for example, in EP-A-0444767 where the control fluid issues from an elongate slot rather than through discrete orifices as in the present invention. Thus, it will be understood that a close control can be exercised over the modification of the flow pattern by appropriate choice of the number, size and direction of the discrete orifices so as to vary the proportion of control fluid which impinges directly against the liquid stream to that which follows the curved surface by virtue of the Coanda effect. It will further be understood that the action of the control fluid issuing through the discrete spaced orifices will also induce a secondary flow of ambient gas from the spaces between discrete orifices over said at least one curved surface. In such a case, it is within the scope of the invention for the control fluid and the ambient gas to be at the same or at different

temperatures. The control fluid may be the same as or different to the ambient gas. Both may be air.

The discrete orifices may be arranged so as to extend at any angle up to 90° relative to the direction of travel of the liquid stream. These orifices may have any suitable shape, for example they may be circular or non-circular. The passage leading to each orifice may be of any desired form, for example, walls of the passage may converge towards the orifice or they may converge and then diverge. The number and size of the orifices may be varied to suit the particular application. Instead of being located at the same level relative to the flow path, the orifices may be located at more than one level. Also, further orifices may be provided downstream of the curved surface.

The curved surface may have any desired degree of curvature or radius. The curved surface or a support structure for such curved surface may be provided with ports therein to allow admission of gas (eg an induced flow of secondary gas) to a downstream region of the curved surface so as to relieve recirculation.

According to said third aspect of the present invention, there is provided a method of modifying the flow pattern of a liquid stream, comprising the steps of causing a liquid stream to flow along a predetermined flow path adjacent to and past at least one curved surface which is curved longitudinally of the flow path; and causing a plurality of discrete jets of control fluid to be directed towards said liquid stream and said at least one curved surface so that discrete portions of the control fluid impinge directly against the liquid stream and whilst other portions of the control fluid follow said at least one curved surface by virtue of the Coanda

effect and are disposed between said liquid stream and said at least one curved surface.

The discrete jets may extend at any angle up to 90° relative to the direction of travel of the liquid stream.

It is an object of fourth and fifth aspects of the present invention to provide an apparatus and method of modifying the flow pattern of a liquid stream which is particularly, but not exclusively, suitable for viscous liquid streams such as chocolate streams and sugar streams.

According to said fourth aspect of the present invention, there is provided apparatus for modifying the flow pattern of a liquid stream, comprising a discharge outlet; means for supplying a liquid to said discharge outlet so as to cause a stream of liquid to be discharged along a predetermined flow path from the discharge outlet; at least one curved surface which is spaced downstream of said discharge outlet and which is curved longitudinally of said flow path; a control fluid supply means disposed so as to cause a control fluid to be supplied between said liquid stream and said at least one curved surface and so as to follow said at least one curved surface by virtue of the Coanda effect; wherein a gas-admission opening is provided adjacent the discharge outlet for introducing a flow of gas internally of the liquid stream passing towards said at least one curved surface in use.

The gas-admission opening may be surrounded by the discharge outlet which may be of any desired cross-sectional shape, for example, it may be annular or it may be defined by a ring of outlet orifices.
Alternatively, there may be provided a pair of mutually parallel spaced

outlet slots for the liquid with the gas-admission opening being disposed between the two outlet slots so that the gas is introduced, in use, between two spaced curtains of the liquid issuing, in use, from the outlet slots. Means may be provided for pressurising the gas. However, it is to be understood that the degree of pressurisation will normally be quite low so as to prevent the liquid stream from being broken apart prematurely in an uncontrollable way.

According to said fifth aspect of the present invention, there is provided a method of modifying the flow pattern of a liquid stream, comprising the steps of causing a liquid stream to flow along a predetermined flow path adjacent to and past at least one curved surface which is curved longitudinally of said flow path; causing a control fluid to flow over said at least one curved surface between said curved surface and said stream and to follow said at least one curved surface by virtue of the Coanda effect whereby to modify the flow pattern of the liquid stream; and introducing gas internally of the liquid stream before the latter reaches said at least one curved surface.

The gas may be introduced internally of an annular discharge opening used to form the liquid stream or internally of a ring of discharge openings used to form the liquid stream. Alternatively, the gas may be introduced between two spaced curtains of liquid. The gas may be pressurised.

The apparatus and method of the second and third aspects of the present invention may be used in combination with the fourth and fifth aspects of the present invention.

An embodiment of the present invention will now be described, by way of example, with reference to the accompanying drawings, in which:
Fig 1 is a schematic sectional view through an apparatus according to said second and fourth aspects of the present invention for carrying out the method according to said first, third and fifth aspects of the present invention, and
Fig 2 is a view of the apparatus of Fig 1 in the direction of arrows B.

Referring now to the drawings, the apparatus comprises a downwardly curved liquid chocolate supply conduit 10 terminating in a vertically downwardly opening annular discharge outlet 12 which is supported in vertically spaced relationship coaxially with and above a circular opening 14 in a horizontal plate 16. The wall 16a of the plate 16 surrounding the opening 14 is annular and is curved longitudinally of the vertical axis A of the discharge outlet 12 and opening 14. A vertically extending air admission tube 18 extends within the lower region of the conduit 10 and has a lower end 18a opening onto the outlet end of the conduit 10 so as to be surrounded by the annular discharge outlet 12.

As can be seen from Fig 1, the nozzles 20 are carried by an annular support plate 30 adjustably mounted on three vertically extending screw-threaded support rods 32 via nuts 34. The support rods 32 also adjustably mount the supply conduit 10 via a respective support plate 36 and nuts 38, and the plate 16 via nuts 40. Thus, the relative vertical spacings between the discharge outlet 12, the opening 14 and the nozzles 20 can be adjusted as desired.

A jacket 42 is provided around part of the conduit 10 to maintain the desired temperature of the chocolate passing through the conduit 10.

The apparatus further comprises a plurality of, in this embodiment, six, nozzles 20 which are equi-angularly spaced around the axis A (Fig 2). Each nozzle 20 has a convergent inner tip 22 leading to a discrete exit orifice 24. The nozzles 20 are inclined, in this embodiment, at an acute angle of about 45° relative to said axis A and are positioned a short distance above the curved annular wall 16a surrounding the opening 14.

In use, liquid chocolate, which may be tempered and which is to be atomised, is allowed to flow under the action of gravity along conduit 10 from a suitable reservoir (not shown). As the chocolate flows through the annular discharge outlet 12, it forms a hollow annular descending stream of chocolate which passes along a predetermined flow path centred on the aforesaid axis A so as to pass through the opening 14. Air drawn through the tube 18 enters the annular stream of chocolate and may, if desired, be subjected to a light pressure (typically up to 0.5 psi) which is sufficient to prevent the chocolate stream from collapsing inwardly but insufficient to cause the hollow annular stream to burst outwardly.

Simultaneously with this, air under pressure is passed through the nozzles 20 so as to be discharged from the discrete orifices 24 surrounding said axis A. The nozzles 20 are directed so that a portion of the air from each orifice 24 impinges directly against the stream of chocolate, in this embodiment, at a respective location which is at a lower end of the opening 14. However, the nozzles 20 are also so directed that a portion of the air issuing from each of the nozzles 20 becomes attached to the curved annular surface 16a defining the opening 14 and follows said surface 16a by virtue of the Coanda effect. Such

Coanda-effect air passes between the wall of the opening 14 and the liquid chocolate stream and thereby prevents the latter from coating the curved surface. Thus, the Coanda-effect air eventually passes vertically downwardly in co-current fashion to the flow of the liquid chocolate stream.

The velocity of air through the nozzles 20 is arranged so that it is much higher than the rate of downward velocity of the liquid chocolate stream. Thus, in addition to causing disruption of the liquid stream by direct impingement of air from the orifices 24, the Coanda-effect air also causes shear forces to be applied to the liquid stream. The combined effect of this is that the liquid chocolate stream is effectively atomised after it has passed through the opening 14. It will be appreciated that, by virtue of the flow of air and chocolate through the opening 14, there will be an induced flow of ambient air from locations between the orifices 24 and between the conduit 10. Such ambient air provides a secondary air flow and further assists in preventing the liquid chocolate stream from coating the wall 16a surrounding the opening 14 and further assists in atomisation of the particles of chocolate. Additionally, on the downstream side of the plate 16, there is no diffuser or other flow-modifying structure, thereby avoiding the provision of further parts which could become coated with chocolate in use.

It will be understood that the desired spray pattern can be achieved by appropriate selection of the number and disposition of the nozzles 20, the size and shape of the orifices 24, and the pressure of air issuing through the orifices 24.

Claim 1

A method of modifying the flow pattern of a stream of liquid chocolate which comprises the steps of causing the chocolate stream to flow from a discharge outlet along a predetermined path and adjacent to and past at least one curved surface and using a co-flowing control fluid which follows said curved surface according to the Coanda effect.

Claim 2

A method as in the previous claims in which the control fluid is supplied via a plurality of discrete orifices which are mutually spaced apart transversally of the predetermined flow path and which are directed towards that flow path such that in use discrete portions of the control fluid impinge directly against the liquid stream whilst other portions of the control fluid follow said at least one curved surface by virtue of the Coanda effect.

Claim 3

A method as described in any of the previous claims in which the liquid stream of chocolate flows from a discharge outlet where a gas admission opening is also provided adjacent to the liquid outlet for introducing a flow of gas internally to the liquid stream as it passes along its predetermined path.

Claim 4

A method according to Claims 2 or 3 in which the liquid stream is a material other than chocolate.

Claim 5

A method as in any of the preceding claims in which the control fluid can be air.

Claim 6

A method according to Claim 2 in which the plurality of jets have a convergent or convergent/divergent profile and which may be circular or any other cross-section.

Claim 7

A method according to Claim 4 in which the gas supplied within the liquid stream can be pressurised.

Claim 8

A method according to Claim 4 in which the gas flow is introduced upstream of where the curved surface is located.

Claim 9

An apparatus comprising an outlet to produce a liquid stream of chocolate along a predetermined path, and a curved surface downstream of the outlet, with a plurality of nozzles to supply a control fluid such that a combined impingement and Coanda effect shear flow can be created to interact with the liquid stream.

Claim 10

A method substantially as herein before described with reference to, and as shown within the accompanying drawing.

The Patent Office

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Application No: GB 9710959.9
Claims searched: 1-10

Examiner: J.H.Warren
Date of search: 6 October 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): B2F (FD, FGF, FHB, FHC)

Int Cl (Ed.6): A23G 1/20, 3/20; B05B 7/08, 7/16, 15/04

Other: ONLINE Databases: WPI, CLAIMS and JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
X	GB 2 125 710 A LECHLER - see page 2 lines 15-34	10
X	EP 0 444 767 A2 ROLLS-ROYCE - see Claim1	10

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.